STARDUST AND INTERPLANETARY DUST PARTICLES – BIG SCIENCE FROM SMALL SAMPLES.

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Comets are primitive bodies that are widely believed to be a reservoir of preserved interstellar and circumstellar grains, and molecular cloud materials (organics). Direct samples of cometary dust along with interstellar grains will be returned by the STARDUST Mission in 2006. Analyses of interplanetary dust particles (IDPs) and analogue materials in the laboratory provide constraints and serve as "ground truth" for evaluating various hypotheses on the nature of comets and interstellar grains. Anhydrous IDPs are the most primitive remnants of the primordial Solar System, and are our only known samples of comets. These cometary IDPs are rich in preserved interstellar organic compounds [1]. In addition, abundant interstellar silicates have recently been discovered in cluster IDPs [2]. In some of these IDPs, the presolar silicate abundance reaches 1 wt %, exceeding the total presolar grain abundance in meteorites by *three orders of magnitude*, where presolar silicates are still notably absent. The results to date support the idea that comets are rich in presolar materials, but are at odds with the common perception that they are 'pristine aggregates of interstellar grains'. These results underscore the scientific importance of sample return missions to comets.

The technology for the analysis of micrometer-sized samples is well advanced. The newest generation of ion probe instruments allow for isotopic analyses at the submicrometer level. The nature of the organic matter is analyzed using Infrared and soft X-ray spectroscopy techniques on synchrotron-based instruments, also at the micrometer-scale and smaller. Electron microscopy and spectroscopy provide details on the mineralogy and chemistry of constituent grains in IDPs at nearly the atomic scale. Novel sample preparation techniques have been developed such that all of these measurements can now be made on the same 10 μm diameter particle. Returned comet samples captured in aerogel will pose new challenges in sample analysis, but should provide a major leap in our understanding of the fundamental building blocks of our Solar System.

References. [1] Keller, L. P. *et al.*, XXXIII LPSC, 1869 (2002) [2] Messenger *et al.*, XXXIII LPSC, 1887 (2002).